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Summary

The determinants and effects of an intensive military training experience on a select group of military trainees were studied. The primary dependent variables were (a) differences in questionnaire scores between graduates and those who drop, and (b) questionnaire score changes from pretest to posttest in graduates. A total of 336 trainees at the U. S. Navy's Basic Underwater Demolition/SEALS (BUD/S) training school were tested at the beginning of their training period; six months later all successful trainees were re-tested up on graduation. The total sample was divided into two groups for cross-validation. Results indicated that (a) Graduates differed consistently from Drops on the Estimation scale of the Physical Estimation and Attraction Scale (PEAS), and four scales on the Hogan Personality Inventory (HPI); (b) Graduates showed consistent posttest changes in the Estimation scale, three out of six scales on the Profile of Mood States (POMS), plus four scales on the HPI. Differences between Graduates and Drops suggested that some aspects of the PEAS and HPI could be used as a screening device in order to reduce attrition. Posttest changes on the PEAS, POMS, and HPI in Graduates were in part consistent with previous work and in part somewhat new, indicating both general and unique features of the BUD/S training experience. (SDW)

A physically strenuous training program is nearly always associated with costly loss of personnel who fail to complete the program. While this problem may occur in any training circumstance, it is generally agreed that more demanding military programs may experience the greatest risk of such attrition--at the greatest cost. This is clearly true in the case of trainees at the U. S. Naval Special Warfare Center during Basic Underwater Demolition/SEALS (BUD/S) training. The general mental and physical difficulties of BUD/S training were graphically described by Rahe, McHugh, Kaplan, Rimon, and Arthur (1972) over 15 years ago as "consisting of extremely arduous physical conditioning and the learning of a number of difficult and dangerous underwater skills" (p. 403). Interestingly, their description remains remarkably accurate today, as does the problem of attrition in this and other training programs.

Obviously, the success of such programs should be evaluated both in terms of the determinants and the effects of the experience itself, i.e., determinants in the sense of differences between successful and unsuccessful trainees, and effects in terms of differences between repeated measures--pretest and posttest comparisons.

Therefore, it is not surprising to find that there have been many reports of studies in which the investigators attempted to predict which subjects would be more likely to complete a training program, using as their predictors any number of potential physical, behavioral, questionnaire, and/or other measures. While the number of such reports is too extensive for a thorough review in the present article, there are several reports that are especially pertinent.

Several groups have shown that standardized questionnaires can be used to discriminate between successful versus unsuccessful trainees in relatively hazardous military training programs. Ryman and Biersner (1975) have reported that attitudes related to "training confidence" were predictive of graduation from both diving and underwater demolition team training. Using several questionnaires, Berard and Hoiberg (1980) assessed the effectiveness of Marine recruits assigned (because of marginal physical skills) to a special conditioning platoon; measures included the Comrey

Personality Scales. Ratings of Marine effectiveness on two-year follow-up (including a cross-validation group) showed significant correlations with three measures of favorable self-perception on the Comrey scales. Cooper (1982) found differences between successful and unsuccessful trainees for bomb disposal operator in Northern Ireland on the Dynamic Personality Inventory, a questionnaire that concentrates on social dimensions of personality, but not on the Sixteen Personality Factor Questionnaire (16PF; Cattell, Eber, and Tatsuoka, 1970), or the Clinical Analysis Questionnaire (Delhees & Cattell, 1971).

More recently, Hogan, Hogan, and Busch (1984) have reported that scores on a test scale designed to measure service orientation (SOI) correlated significantly with criterion measures of job performance in four independent samples. In addition, SOI scores in a large group of Navy volunteers correlated with 15 of 18 standard scales on the California Psychological Inventory (CPI) suggesting that the SOI measure may be an index of general competency. Similarly, Biersner and Hogan (1984) found significant relationships between scores on the Hogan Personality Inventory (HPI), which included the SOI scale, and measures of success of U.S. Navy personnel at the conclusion of a winter tour of duty in Antarctica. In general, all of the foregoing studies give support to the notion that some personality inventories or similar questionnaires can be useful in predicting success in a difficult and challenging military training program.

At the same time, another (much smaller) group of investigators has studied changes in questionnaire scores over the course of a military training program. Such comparisons of pretest and posttest scores could potentially shed additional light on the problem of predicting ultimate success in a somewhat different manner and also provide further data on the effects of the training experience per se on those who graduate. That is, additional knowledge about characteristics of successful trainees could potentially assist in initial selection, as well as broaden our understanding of the effects of the training experience itself. This would then permit further investigation of relationships between characteristics of graduates and later performance in the field, along with other applications.

Two such reports with repeated measurements are those by Rahe, Rubin, Gunderson, and Arthur (1971), and Rahe, McHugh, Kaplan, Rimon, and Arthur (1972). Rahe et al. (1971) studied the mood questionnaire correlates of serum cholesterol over two months in a group of 20 BUD/S trainees. They used a shortened version of the Radloff and Helmreich (1968) mood scale checklist, a potential problem to which we return below. Results showed consistent negative correlations with measures of motivation, arousal, and happiness, and consistent positive correlations with measures of depression, anger, fear, and lethargy. There were no significant mood changes over the two month period, except briefly near the middle during the phase called "hell week," a uniquely stressful period. Rahe et al. (1972) studied repeated lactic acid measures, correlated with scores on the Cornell Medical Index (CMI), in a similar group of 84 BUD/S trainees. In general, lactic acid measures did not correlate with CMI scores, although significant increases in lactic acid were observed in successful trainees.

While it might be viewed as somewhat disappointing that (a) mood scores did not change appreciably over the training period, and that (b) CMI scores did not correlate with measures of lactic acid, there remain several methodological questions that could account for these findings. For example, the revised mood scales used by Rahe et al. (1971) were actually shortened from 67 to 40 adjectives in checklist form, and the authors point out that the intercorrelations among the mood scales were "moderately high (p. 400)." Similarly, the failure to find relationships between lactic acid measures and CMI scores could reflect a more general lack of relationship between these two measures, as well as the questionable usefulness of the CMI in this context.

A later study by Kowal, Patton, and Vogel (1978) does indeed suggest that a more comprehensive and experience-based choice of questionnaires can detect changes in standardized test scores after a period of intensive military training. These authors studied 400 Army recruits before and after basic training, with equal numbers of male and female trainees. It should be noted, however, that the sample actually consisted of two groups, one tested only at the beginning of basic training, and one tested only after basic training. Such a design avoids the practice effect of taking all

questionnaires twice, but there still remains the possibility that any observed results could be due to initial differences between groups.

Kowal et al. included pre/post measures of aerobic fitness, an important validating measure of the effects of training. Female subjects showed no improvement in fitness, weight, percent body fat, or scores in an Army fitness performance test. The male trainees, however, did show significant improvement in fitness measures, plus improvement in fitness performance, and a decrease in percent body fat. The male trainees showed significant changes in most measures of mood state, state anxiety, and physical self-concept, but no differences on more enduring personality traits of extraversion, trait anxiety, or emotionality.

Therefore, in part to deal with the questions that remain from previous articles, and in part to extend their initial findings into new areas, the following report consists of a study in which all trainees were tested at the start of an intensive training experience, and all graduates were re-tested at the time of graduation. In so doing, we were able to compare (a) initial test scores of graduates versus dropouts, and (b) pre/post changes in graduates as a function of the training experience. We were thus able to measure the initial characteristics of successful trainees, and the effect of the training experience itself on those who completed the training successfully. Information on initial characteristics could lead to improved screening and selection of trainees, in order to reduce attrition, and information on changes in training could lead to improved understanding of the nature of training, plus more useful data related to subsequent performance in the field. We also included a cross-validation group in order to minimize problems associated with sampling error.

Method

Subjects

The subjects were 336 male trainees at the U.S. Naval Special Warfare Center, Coronado, California, undergoing training for Basic Underwater Demolition/SEALS (BUD/S). The sample consisted of all members of three

consecutive classes, each of which started and completed BUD/S training in 1986.

Data from the three classes were pooled and divided into two groups by random selection. This was done to create an equivalent cross-validation group which would be approximately equal to the original comparison group on such extraneous variables as seasonal/climatic effects, plus cohort and instructional changes across classes.

This resulted in two groups, an initial comparison group and a cross-validation group, labeled Groups 1 and 2, respectively. The final resulting N's in Groups 1 and 2 are given in Table 1. It should be noted that the groups differ somewhat in N's partly because of differential incidence of "rollbacks" (those given delays for various temporary reasons), all of whom were excluded from the present report.

Each Group was further divided into Graduates and Drops. Graduates were those trainees who completed the training course in a normal manner. Drops included all who discontinued in the program for whatever reason (except rollbacks). We initially kept separate data for "medical" drops and "voluntary" drops; however, the number of medical drops was small, and the interrater consistency of classifying drops as medical versus voluntary was somewhat variable (except in extreme cases, such as broken bones). In addition, there were no differences between medical drops and voluntary drops on any of the dependent variables to be reported herein. Therefore, these subgroups were combined into the Drop groups in the present report.

Table 1
Means and Standard Deviations of Graduates and Drops in Groups 1 and 2
for Age, Height, Weight, and Percent Body Fat

<u>N's</u>	<u>Group 1</u>	<u>Group 2</u>
Graduates	23	39
Drops	146	128
Total	169	167

(table continues)

	<u>Group 1</u>		<u>Group 2</u>	
	<u>Mean</u>	<u>s.d.</u>	<u>Mean</u>	<u>s.d.</u>
Age				
Graduates	22.8	3.13	22.2	3.10
Drops	22.2	3.14	22.8	3.41
Height (cm)				
Graduates	175.9	6.22	175.3	5.52
Drops	176.5	6.30	177.0	6.21
Weight (kg)				
Graduates	76.0	7.32	75.9	7.73
Drops	78.0	7.96	75.7	7.17
Percent Body Fat				
Graduates	12.5	2.87	12.9	3.23
Drops	13.8	3.57	13.7	3.61

Note: None of the differences between Groups 1 and 2 were statistically significant.

Means and standard deviations for Graduates and Drops in Groups 1 and 2 for age, height, weight, and percent body fat are given in Table 1. Percent body fat was based on a Navy equation developed by Hodgdon and Beckett (1984), using abdomen and neck circumferences, plus height. There were no significant differences between Groups or between Graduates and Drops on any of the variables presented in Table 1, thus indicating that the Groups were initially comparable on these variables.

Design

Data for the present study were collected at two points in each of the three BUD/S classes which made up the total sample. First, initial measures were taken two to six days before the beginning of Indoctrination at the start of BUD/S training. These measures included the demographics summarized in Table 1, plus further measures of fitness (e.g., sit-ups, push-ups, run time, swim time, etc.) and the questionnaires described below. Additional fitness data will be reported separately and are not included in this report.

Second, all of the questionnaires were re-administered to all Graduates at the completion of the six months of BUD/S training. Questionnaires were given during the week prior to graduation, generally two days before graduation. Thus all Graduates were tested twice (pretest and posttest),

and all Drops were tested once (pretest only).

Measures

The questionnaires administered to all subjects consisted of the following:

(1) The NHRC History of Physical Activities Questionnaire (HOPA). This is a physical activities history questionnaire designed by the authors.

(2) The Physical Estimation and Attraction Scales (PEAS; Sonstroem, 1974). This is a 100-item true/false questionnaire which has been shown by Sonstroem (1976) to correlate with self-perceptions of physical and athletic abilities and was also useful in the Kowal et al. (1978) study described above.

(3) The Profile of Mood States (POMS; McNair, Lorr, and Droppleman, 1971). This is a 65-item adjective checklist, in which subjects are instructed to rate each item from one to four, indicating "not at all" to "extremely," during the past week including today. Responses are scored on six non-overlapping mood scales: Tension, Depression, Anger, Vigor, Fatigue, and Confusion. In addition to being one of the most widely used mood scales (Eichman, 1978), the POMS was found by McDonald and Hodgdon (1988) to be the most useful measure of mood changes following aerobic fitness training and was also the most significant discriminator in the recruit study by Kowal et al. (1978).

(4) The Tennessee Self Concept Scale (TSCS; Fitts, 1965). This is a 100-item self-concept questionnaire in which subjects are asked to rate a variety of statements from one to five, indicating "completely false" to "completely true," respectively. In addition to being one of the most widely used self-concept questionnaires (McDonald and Hodgdon, 1988), the TSCS also provides a measure which one might expect to show meaningful changes in BUD/S trainees, i.e., total self-concept.

(5) The Hogan Personality Inventory (HPI; Hogan, 1985). This is a 310-item true/false questionnaire which yields 13 standard scores, listed

below. The HPI was found by Biersner and Hogan to be a useful predictor of success of Navy personnel in Antarctica and was also found to be a useful instrument by Hogan, Hogan, and Busch (1984) in predicting measures of job performance in a variety of occupational groups.

All questionnaires were administered in the order listed above and in the standard manner. Subjects were instructed to read the instructions and respond to all items as best they could. At least one member of the research team was present at all times during the administration.

Results

Each of the test instruments used in the present study offered some choice in scales or scores to be used. In general, we chose those scales which offered the most reliable, independent, and rationally predicted relationships in BUD/S trainees. Shorter scales (often less reliable), scales that overlapped with others, longer (i.e., intercorrelated) scales in the same instrument, and scales that were not found to be useful discriminators in previous studies were not chosen. For example, both the PEAS and the TSCS can be scored for a number of additional scales; however, they were not included for all of the foregoing reasons. These considerations, plus the fact that we used a cross-validation group, justified use of one-tailed tests in the analysis.

Therefore, the following are the scales that were investigated in the present study. PEAS: Estimation and Attraction scales; POMS: Tension, Depression, Anger, Vigor, Fatigue, and Confusion; TSCS: Total Self-Concept; HPI: Intellectance, Adjustment, Prudence, Ambition, Sociability, Likeability, Validity, Service Orientation, Resiliency, Reliability, Clerical Potential, Sales Potential, and Managerial Potential. Data from the HOPA (physical activity history questionnaire) are not included in the present report.

Graduates versus Drops

Means, standard deviations, and one-tailed t -test results of comparisons between Graduates and Drops in Groups 1 and 2 for all

questionnaires are summarized in Table 2. Graduates and Drops in each Group were compared by means of t-tests on each of the questionnaire scales reported.

As can be seen in Table 2, 8 out of 22 comparisons between Graduates and Drops in Group 1 were statistically significant at $p < .05$ or better, and 16 out of 22 comparisons were significant in Group 2, whereas chance alone would lead one to expect one or two comparisons significant out of 22. Of these significant comparisons, 5 out of 22 were significant in both Groups, i.e., the results were replicated. These replicated differences between Graduates and Drops were - PEAS: Estimation score, and HPI: Adjustment, Likeability, Service Orientation, and Managerial Potential scales. It should be noted that Graduates scored higher than Drops on all five of the replicated differences shown in Table 2. These findings strongly indicate that the PEAS and HPI could be used as screening devices in selecting BUD/S trainees, either directly or in modified form.

Table 2
Means, Standard Deviations, and t-test Results,
Comparing Graduate-Pretest Scores
with (a) Drops Scores and (b) Graduate-Posttest Scores
on the PEAS, POMS, TSCS, and HPI

	<u>Mean</u>	<u>s.d.</u>	<u>Mean</u>	<u>s.d.</u>
1. <u>PEAS</u>				
Estimation				
Drops	24.4*	8.38	23.8**	8.00
Grads-Pretest	27.5	4.13	26.9	4.59
Posttest	29.2***	3.78	30.0***	2.79
Attraction				
Drops	40.1*	12.71	39.7	12.69
Grads-Pretest	45.3	4.10	43.2	7.14
Posttest	44.4	4.47	43.8	4.78
2. <u>POMS</u>				
Tension				
Drops	11.1	5.69	12.1	6.76
Grads-Pretest	9.5	5.82	10.8	6.28
Posttest	6.7*	5.23	8.6**	4.98
Depression				
Drops	5.9	6.54	6.1*	7.47
Grads-Pretest	3.7	5.44	3.8	4.45
Posttest	2.8	4.00	4.2	6.75

(table continues)

2. POMS (cont)		Mean	s.d.	Mean	s.d.
Anger					
Drops		5.9	6.00	6.8	7.31
Grads-Pretest		5.3	4.15	5.7	4.95
Posttest		8.9*	6.73	8.8***	6.10
Vigor					
Drops		21.6	5.47	21.1	5.23
Grads-Pretest		21.9	4.40	22.0	3.94
Posttest		22.7	4.27	22.0	4.87
Fatigue					
Drops		5.6*	4.99	6.1	5.16
Grads-Pretest		3.7	3.39	4.7	4.90
Posttest		5.8*	3.87	6.5*	5.04
Confusion					
Drops		5.1	3.88	5.6*	4.38
Grads-Pretest		5.0	4.16	3.9	4.22
Posttest		3.7*	3.97	3.7	3.42
3. TSCS					
Total Self-Concept					
Drops		355.3	35.23	354.8*	32.82
Grads-Pretest		365.6	27.19	366.3	34.90
Posttest		360.5	31.36	367.1	34.55
4. HPI					
Intellectance					
Drops		18.3	7.42	17.8***	7.52
Grads-Pretest		19.7	4.57	22.0	4.31
Posttest		19.0	5.40	20.1**	5.65
Adjustment					
Drops		30.7*	11.12	30.7*	10.96
Grads-Pretest		35.7	6.08	34.5	6.77
Posttest		35.3	6.44	34.8	6.51
Prudence					
Drops		20.4	8.56	20.1*	8.12
Grads-Pretest		22.2	4.55	23.1	5.93
Posttest		21.2	4.70	21.7*	5.61
Ambition					
Drops		19.7	6.63	19.3*	6.46
Grads-Pretest		20.9	2.54	21.4	2.87
Posttest		21.1	2.28	20.9	3.61
Sociability					
Drops		11.1*	5.20	11.2	5.20
Grads-Pretest		13.0	3.82	12.0	3.92
Posttest		13.8	3.22	13.1**	3.93
Likeability					
Drops		19.0*	6.63	18.7*	7.11
Grads-Pretest		21.9	2.88	20.8	3.67
Posttest		19.7*	4.42	19.8*	4.23
Validity					
Drops		13.8	4.30	14.0*	4.28
Grads-Pretest		15.1	1.22	15.4	0.96
Posttest		14.2*	2.22	14.4**	2.09

(table continues)

4. HPI (cont)	Mean	s.d.	Mean	s.d.
Service Orientation				
Drops	59.9*	18.62	59.8*	18.80
Grads-Pretest	66.6	6.20	66.5	5.69
Posttest	62.3**	8.06	63.4*	9.13
Resiliency				
Drops	30.8	10.69	29.8*	10.03
Grads-Pretest	34.1	5.19	33.1	6.51
Posttest	33.1	4.48	31.7	6.55
Reliability				
Drops	37.7	13.57	37.7*	13.64
Grads-Pretest	42.3	6.71	42.7	7.34
Posttest	38.6**	6.86	40.1**	7.81
Clerical				
Drops	16.1	5.68	16.4*	5.72
Grads-Pretest	17.6	2.92	18.4	3.56
Posttest	17.9	3.04	18.0	3.10
Sales				
Drops	13.6	4.56	13.2*	4.78
Grads-Pretest	13.5	2.57	14.7	2.51
Posttest	13.1	2.43	14.0	2.33
Managerial				
Drops	36.3*	11.76	36.3*	12.16
Grads-Pretest	41.4	5.72	40.8	5.18
Posttest	40.1	7.02	39.6	6.52

Note: Statistically significant comparisons with the Graduate-Pretest scores are indicated as follows: * $p < .05$, one-tailed; ** $p < .01$, one-tailed; *** $p < .001$, one-tailed.

Pretest versus Posttest Scores of Graduates

Means, standard deviations, and one-tailed t -test results of pretest versus posttest comparisons in Graduates in Groups 1 and 2 for all questionnaires are also summarized in Table 2. As can be seen, 9 out of 22 pretest versus posttest comparisons in Graduates were statistically significant in Group 1 at $p < .05$ or better, and 11 out of 22 such comparisons were statistically significant in Group 2. As above, one would expect one or two out of 22 to be significant by chance alone.

Of the significant pretest vs posttest comparisons, 8 out of 22 were statistically significant in both Groups, meaning that the findings were replicated in those cases. The replicated pretest vs posttest changes (with sign showing direction of change on posttest), were - PEAS: Estimation (+); POMS: Tension (-), Anger (+), Fatigue (+); HPI: Likeability (-), Validity (-), Service Orientation (-), and Reliability (-). These results indicate

that Graduates did show certain changes in physical self-concept, mood, and personality variables as a function of training.

Discussion

In general, the primary findings of the present investigation may be summarized as follows: (a) trainees who graduate from BUD/S differed from those who drop on a number of pretest measures taken at the initiation of BUD/S training, most notably the Estimation scale on the PEAS, and the Adjustment, Likeability, Service Orientation, and Managerial Potential scales of the HPI; and (b) trainees who graduated from BUD/S showed a number of changes from pretest to posttest, most notably the Estimation scale on the PEAS, Tension, Anger, and Fatigue on the POMS, and Likeability, Validity, Service Orientation, and Reliability on the HPI.

The fact that Graduates were found to differ from Drops on several measures is consistent with earlier reports of similar studies but also represents an extension of the previous work in a new area, viz, BUD/S. The fact that the Service Orientation scale (plus three others) on the HPI significantly discriminated between Graduates and Drops is consistent with the reports by Hogan, Hogan, and Busch (1984) and Biersner and Hogan (1984). Similarly, the data reported by Kowal, Patton, and Vogel (1978) clearly supports the result that the Estimation scale on the PEAS was a significant discriminator, a finding consistent with the results reported by McDonald, Beckett, and Hodgdon (1988), although the latter found the Attraction scale to be more useful in a more typical Navy sample of both males and females.

It would appear that Graduates tend to have a higher estimation of their physical abilities, perhaps based on more reinforcing past experiences, plus other differences based on the HPI data. Hogan's (1985) description of the characteristics measured by each of the four significant scales is potentially of interest: Adjustment - measures self-esteem, self-confidence, and freedom from anxiety; Likeability - measures the extent to which individuals are cordial and even-tempered; Service Orientation - identifies persons disposed to be helpful and courteous; Managerial

Potential - predicts success in occupations that require leadership ability, planning, and decision-making skills.

Thus, Graduates appear to show more physical self-confidence, self-esteem, teamwork skills, and leadership potential. Such findings are not only logically sensible but also strongly indicate that some combination of the PEAS and/or HPI should be useful predictors of future graduates from BUD/S training. This question would require further research, including cross-validation.

That the Graduates changed on a number of measures from pretest to posttest is consistent with previous work, but also represents in part some new findings. For example, Kowal et al. found that five out of six scales on the POMS changed in male subjects in basic training, whereas we found changes in three out of six scales.

Therefore, it seems well established that such training programs produce mood changes of some magnitude. On the other hand, the specific mood changes found in the two studies differ noticeably. Whereas Kowal et al. reported decreases in Tension scores (as did we), they reported a decrease in Fatigue scores and no change in Anger scores, where we found that both increased.

On the other hand, Kowal et al. found that the Estimation scale on the PEAS increased significantly in graduates, as did we. In fact, the changes in this scale were consistently the most significant in the present report, suggesting that increases in physical self-concept are perhaps the most notable changes in graduates from BUD/S.

Quite likely some of these differences in results reflect differences in the two programs. Certainly no eyewitness would be surprised to find that BUD/S graduates report an increase in fatigue. Further, the increase in Anger scores quite possibly reflects the severity of physical stress--a unique aspect of BUD/S training. The questionnaires thus seem to reflect both general and specific features of the training experience. It would clearly be of long term interest to conduct follow-up testing of graduates

at some later time to assess the durability of changes apparent at the time of graduation.

One of the more unexpected findings in the present study was the observation that all of the significant changes in the HPI on posttest in graduates were decreases. Thus, graduates seemed to be less likeable, to respond with less validity, to be less service oriented, and to be less reliable. Such score changes could indicate (a) real change, (b) change in response set, or (c) some combination of both. For example, it seems reasonable to hypothesize some degree of response set on the pretest, such as response expectancy. That is, subjects might have responded in part as they thought they were expected to respond, a response set that could conceivably play a larger role at the start of BUD/S training, but which would diminish appreciably at graduation.

This is not to say that there were no real changes, and, in fact, it seems more likely that posttest scores in graduates reflected both real change and response set change in combination. This is even more likely since graduates did not show decreases in all scales of the HPI on posttest, including scores on such scales as Adjustment and Managerial Potential, where scores were higher on pretest than the scores of those trainees who dropped. Hence the posttest changes did not indicate a general decline in any set-related behaviors across all scales.

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indicating both general and unique features of the BUD/S training experience.